*B. anthracis*

Disease :*B. anthracis* causes anthrax, which is common in animals but rare in humans. Human disease occurs in three main forms: cutaneous, pulmonary (inhalation), and gastrointestinal. In 2001, an outbreak of both inhalation and cutaneous anthrax occurred in the United States. The outbreak was caused by sending spores of the organism through the mail.

Important Properties

*B. anthracis* is a large gram-positive rod with square ends, frequently found in chains. Its antiphagocytic capsule is composed of **D-glutamate.** (This is unique capsules of other bacteria are polysaccharides.) It is nonmotile, whereas other members of the genus are motile. Anthrax toxin is encoded on one plasmid and the polyglutamate capsule is encoded on a different plasmid

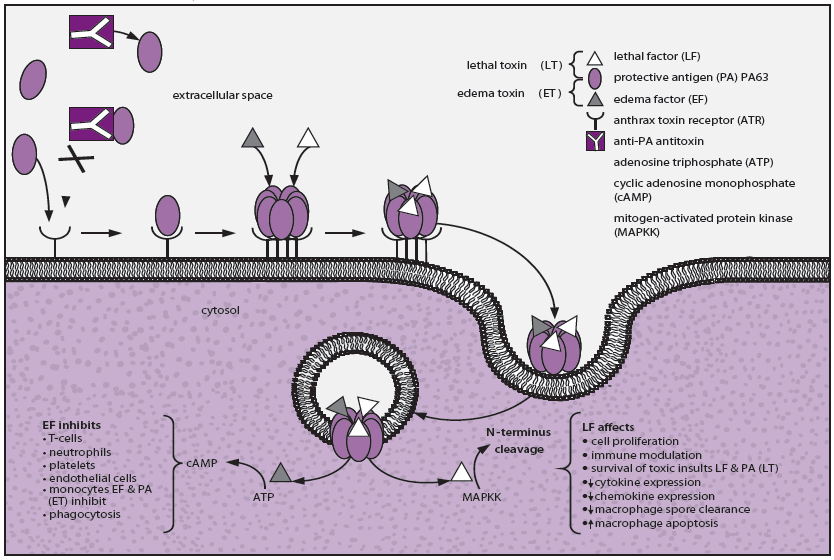
Transmission

Spores of the organism persist in soil for years. Humans are most often infected cutaneously at the time of trauma to the skin, which allows the spores on animal products, such as hides, bristles, and wool, to enter. Spores can also be inhaled into the respiratory tract. Pulmonary (inhalation) anthrax occurs when spores are inhaled into the lungs. Gastrointestinal anthrax occurs when contaminated meat is ingested. Inhalation anthrax is not communicable from person-to-person, despite the severity of the infection. After being inhaled into the lung, the organism moves rapidly to the mediastinal lymph nodes, where it causes hemorrhagic mediastinitis. Because it leaves the lung so rapidly, it is not transmitted by the respiratory route to others.

Pathogenesis

Pathogenesis is based primarily on the production of two exotoxins, collectively known as anthrax toxin. The two exotoxins, edema factor and lethal factor, each consist of two proteins in an A-B subunit configuration. The B, or binding, subunit in each of the two exotoxins is protective antigen. The A, or active, subunit has enzymatic activity.

Edema factor, an exotoxin, is an adenylate cyclase that causes an increase in the intracellular concentration of cyclic AMP. This causes an outpouring of fluid from the cell into the extracellular space, which manifests as edema. Lethal factor is a protease that cleaves the phosphokinase that activates the mitogen-activated protein kinase (MAPK) signal transduction pathway. This pathway controls the growth of human cells, and cleavage of the phosphokinase inhibits cell growth. Protective antigen forms pores in the human cell membrane that allows edema factor and lethal factor to enter the cell. The name protective antigen refers to the fact that antibody against this protein protects against disease.



Clinical Findings

The typical lesion of cutaneous anthrax is a painless ulcer with a black eschar (crust, scab). Local edema is striking. The lesion is called a malignant pustule. Untreated cases progress to bacteremia and death.

Pulmonary (inhalation) anthrax, also known as "woolsorter's disease," begins with nonspecific respiratory tract symptoms resembling influenza, especially a dry cough and substernal pressure. This rapidly progresses to hemorrhagic mediastinitis, bloody pleural effusions, septic shock, and death. Although the lungs are infected, the classic features and x-ray picture of pneumonia are not present. Mediastinal widening seen on chest x-ray is an important diagnostic criterion. Hemorrhagic mediastinitis and hemorrhagic meningitis are severe life-threatening complications. The symptoms of gastrointestinal anthrax include vomiting, abdominal pain, and bloody diarrhea.

Laboratory Diagnosis

Smears show large, gram-positive rods in chains. Spores are usually not seen in smears of exudate because spores form when nutrients are insufficient, and nutrients are plentiful in infected tissue. Non hemolytic colonies form on blood agar aerobically. In case of a bioterror attack, rapid diagnosis can be performed in special laboratories using polymerase chain reaction (PCR)-based assays. Another rapid diagnostic procedure is the direct fluorescent antibody test that detects antigens of the organism in the lesion. Serologic tests, such as an ELISA test .

Treatment & Prevention

Ciprofloxacin is the drug of choice. Doxycycline is an alternative drug.

Ciprofloxacin or doxycycline was used as prophylaxis in those exposed during the outbreak in the United States in 2001. People at high risk can be immunized with cell-free vaccine containing purified protective antigen as immunogen. Incinerating animals that die of anthrax, rather than burying them, will prevent the soil from becoming contaminated with spores.

***Bacillus cereus***

Food poisoning caused by *B cereus* has two distinct forms: the emetic type, and the diarrheal type. The emetic form is manifested by nausea, vomiting, abdominal cramps, and occasionally diarrhea and is self-limiting, with recovery occurring within 24 hours. It begins 1–5 hours after ingestion of contaminated food. The diarrheal form has an incubation period of 1–24 hours and is manifested by profuse diarrhea with abdominal pain and cramps; fever and vomiting are uncommon. The enterotoxin may be preformed in the food or produced in the intestine. The presence of *B cereus* in a patient's stool is not sufficient to make a diagnosis of *B cereus* disease, since the bacteria may be present in normal stool specimens; a concentration of 105 bacteria or more per gram of food is considered diagnostic.

*B cereus* is an important cause of eye infections, severe keratitis, endophthalmitis, and panophthalmitis. Typically, the organisms are introduced into the eye by foreign bodies associated with trauma. *B cereus* has also been associated with localized infections and with systemic infections, including endocarditis, meningitis, osteomyelitis, and pneumonia; the presence of a medical device or intravenous drug use predisposes to these infections. *B cereus* is resistant to a variety of antimicrobial agents including penicillins and cephalosporins. Serious nonfood-borne infections should be treated with vancomycin or clindamycin with or without an aminoglycoside.